



**ENGINEERS  
AUSTRALIA**  
Western Australia Division

**NOMINATION**  
**MITCHELL FREEWAY STAGE 1**  
**FOR A**  
**NATIONAL ENGINEERING LANDMARK**



**PREPARED BY ENGINEERING HERITAGE PANEL  
ENGINEERS AUSTRALIA  
WESTERN AUSTRALIA DIVISION**

**SEPTEMBER 2008**

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Mitchell Freeway National Engineering Landmark Nomination

Appendix A

Plaque Nomination Form


Name of Work : Mitchell Freeway Stage 1

Nominate for : National Engineering Landmark

Location : City of Perth , Western Australia, between 31 57' 47" S,  
115 50' 49" E and 31 56' 37" S, 115 50' 56" E.

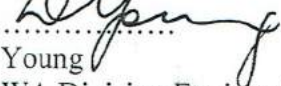
Owner: Main Roads Department, Western Australia  
PO Box 6202, East Perth, WA 6892

Nominating Body : Engineering Heritage Panel, Engineers Australia, WA  
Division

( Signed ) .....   
D Young  
For Nominating Body

Date ..10 September 2008

This plaquing nomination is supported and is recommended for approval.

( Signed ) .....   
D Young  
Chair, WA Division Engineering Heritage Panel

Date ..10 September 2008

Enquiries: Dean Roberts on 9323 4638  
Our Ref: 07/1082  
Your Ref:

ABN: 50 860 675 021

The Administrator  
Engineering Heritage Australia  
Engineers Australia  
11 National Circuit  
Barton ACT 2600

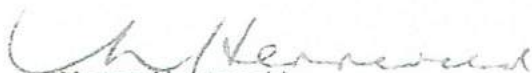
Dear Sir/Madam

**MITCHELL FREEWAY STAGE 1  
NATIONAL ENGINEERING LANDMARK NOMINATION**

This letter accompanies the nomination by the Engineering Heritage Panel of Engineers Australia, Western Australia Division for the Mitchell Freeway Stage 1 to be awarded a National Engineering Landmark and confirms the support of Main Roads Western Australia for that nomination.

Should you have any queries please contact the Main Roads' Manager Public Affairs,  
Mr Dean Roberts on (08) 9323 4638.

Yours sincerely



Menno Henneveld  
COMMISSIONER OF MAIN ROADS

12 SEP 2008



## Appendix B : Plaquing Nomination Assessment Form

### 1. BASIC DATA

**Item Name :** Mitchell Freeway Stage 1

**Location :** Stage 1 of the Mitchell Freeway, Perth, Western Australia, extends from the north abutment of the Narrows Bridge to the Hamilton Interchange in West Perth.

**Local Government Area** City of Perth

**Owner** Main Roads Department, Western Australia

**Current Use:** The roads and bridges of the Mitchell Freeway are used by approximately 85,000 northbound vehicles per week day, allowing traffic between Perth's southern and northern suburbs to bypass the CBD and also permitting access from the CBD to various metropolitan suburbs.

**Designer** The Narrows Interchange was designed by the Main Roads department staff. The Central Section and the Hamilton Interchange were designed by De Leuw Cather of Chicago, which had specific expertise in geometric road design, with selected MRD WA staff as part of the design team.

### Major Construction Contractors

Narrows Interchange : Citra Construction Pty Ltd

Central Section : Clough Engineering - Kier Ltd Joint Venture

Hamilton Interchange : P.D.C. Pty Ltd

### Time Frame

In 1961 MRD Bridge Engineer Mr J G Marsh spent twelve months in the UK where, among other things, he undertook studies in soil mechanics at Imperial College, London, under Professor Sir Alec Skempton. His particular interest was in techniques which could be used for the rapid consolidation of the mud under the future Narrows Interchange site.

## 2.

On returning to Perth in 1962 Mr Marsh initiated a trial of sand draining techniques in the mud layer of the Narrows Interchange area. The success of this trial convinced the Department that the whole of the reclaimed area could be adequately consolidated to support the high road embankments required within the interchange.

Commencing in 1964 the MRD carried out, over a four year period, an extensive stabilisation of a 37 hectare reclaimed area north of the bridge to accommodate the roads and bridges of the Narrows Interchange. The average consolidation settlement was six metres.

Concurrently planning for the three sections was carried out and design and construction of the three sections of Stage 1 was completed by November 1973.

Construction of the Central Section was carried out during 1966 – 1968 and the Hamilton Interchange between 1969 and 1972.

### Physical Description

#### Narrows Interchange

The interchange consists of 26,550 square metres of prestressed concrete bridge deck and 29.4 kms of freeway standard road pavements. Before bridge works commenced the MRD stabilised, over a four year period the mud layers of the reclaimed area. This was done by the installation of 43,000 vertical sand drains, about 800 km in total length. Approximately three million cubic metres of sand was trucked to the site to consolidate the mud and provide material for embankments. The scale of this stabilisation process was unique in Australian, and probably the world, civil engineering construction at that time. In anticipation of further long term settlement the bridge foundations consisted of hollow jointed concrete caissons with the bridge piers built within them. The annular space allowed for possible differential horizontal and vertical movements. The combined length of the thirteen caissons sunk to bedrock is approximately 450 metres. The caissons average mass is 2000 tonnes and average length is 34.5 metres; the diameters varying from 7.4 to 10.8 metres. In total 41,000 cm of concrete and 1222 tonnes of high tensile steel were used in the project.

### 3.

#### Central Section

The central section comprised three reinforced concrete cast in situ box girder bridges on reinforced concrete piers. One of the bridges had piled foundations. A deep cutting through a built-up area required 230,000 cubic metres of excavation and 1800 lineal metres of reinforced concrete retaining walls varying in heights up to 6.6 metres. For the first time in Western Australia large sheets of waterproof plywood were imported from NSW to be used in the retaining wall formwork, thus minimising off form joint marking. For the first time in WA freeway standard road pavements were constructed.

#### Hamilton Interchange

Connecting to the northern end of the Central Section the Hamilton Interchange consisted of cast insitu box girder post tensioned concrete bridges over Wellington, Roe, Aberdeen and James Streets and the Perth to Fremantle railway. Compacted pile foundations were used. These bridges were unique in Western Australia in that it was the first time large multi wired prestressing cables, requiring a 500 tonne capacity prestressing jack to tension the cables, had been used.

#### Physical Condition and Modifications

The infrastructure is in excellent condition. Some changes have been made to the road layout in the Narrows Interchange area and new overpass bridges provided to allow for a new suburban rail link from central Perth south to Mandurah.

#### Historical Notes

On 18 November, 1966 a ceremony was held at the Murray Street bridge site when the then Premier of Western Australia, the Hon. David Brand, pulled a lever to begin the first concrete pour on the Central Section. He then unveiled a plaque which was subsequently fixed, with another one, on a Murray Street bridge retaining wall and unveiled by Lady Brand, widow of Sir David Brand, on 18 November, 1982.



4.

### **Heritage Listing**

There are no heritage listings for the Mitchell Freeway, Western Australia.



## **APPENDIX C : ASSESSMENT OF SIGNIFICANCE**

### **Historic Phase**

With the completion of the Narrows Bridge in 1959 Perth had a direct connection to its immediate and distant southern suburbs. Part of the Stephenson Metropolitan Area plan, a modern road system linking Perth's northern, southern, western and eastern suburbs was required to avoid traffic congestion for vehicles entering, leaving and bypassing Perth's CBD. Planned, designed and constructed by 1973 the Mitchell freeway Stage 1 successfully achieved that requirement.

### **Historic Individuals or associations**

Appendix D includes mini biographies of Sir David Brand, Mr D H Aitken, Mr W H Clough and Mr J G Marsh.

Sir David Brand was Premier of Western Australia when the construction work on the freeway commenced in 1966. Mr D H Aitken was Commissioner of Main Roads when most of the freeway design and construction work was carried out. Mr W H Clough was Managing Director of Clough and Son, a joint venture partner with Kier Ltd, contractors for the Central section of Stage 1. Mr J G Marsh was the MRD Bridge Engineer responsible for the design of the earthworks stabilisation and structural design for the Narrows Interchange.

### **Creative or Technical Achievement**

There were several notable creative and technical achievements arising from the design and construction of Stage 1 of the Mitchell Freeway. They were, not necessarily in order of importance :-

- The innovative method of compressing the mud layers of the reclaimed Mounts Bay by installing sand drains and sand surcharge, on a scale never before attempted in Australia and probably in the world.
- The decision to sink concrete caissons to isolate supporting bridge piers from the effects of future horizontal or vertical movements due to further settlement of the subsurface mud layers.
- The construction of freeway roads and bridges requiring a deep cutting through the western business district of Perth with minimal disruption to traffic flows and damage to adjacent structures..

## Social

The completion of the link from the Kwinana Freeway via the Narrows Bridge to the Hamilton Interchange allowed traffic to flow more smoothly between Perth's northern and southern suburbs, by-passing the CBD, and permitted easier access from the western end of the CBD to Perth's southern, western and northern suburbs. Provision was made in the design for future connections to a bypass tunnel and highway leading to the eastern suburbs.

A lot of thought went into the landscaping of the Narrows Interchange. Landscape architects were employed to plan for the creation of scenic lakes and gardens between the roadways which people could access by foot and cycle paths. It was important to maintain a pleasing vista from Kings Park, a favourite viewing location overlooking Perth. Similar planning allowed for the provision of access paths and vegetated verges behind the retaining walls of the Central Section.

## References

The Vital Link, A History of Main Roads Western Australia 1926 – 1996, by Leigh Edmonds.

Making a Start on Mitchell Freeway, Main Roads internal document ca 1973.

## Statement of Significance

Stage 1 of the Mitchell Freeway, Perth, Western Australia, is a highly significant undertaking in road infrastructure in Australia. Completed in 1973, nineteen years after reclamation of Mounts Bay in the Swan River had commenced and nine years after the first sand drain had been installed in the reclaimed area. The Narrows Interchange, the largest section of the project, incorporated innovative solutions to the problem of constructing roads and bridges on an unstable mud layer. A combination of sand draining and sand fill compressed the mud to an acceptable degree and the use of large concrete caissons protected the bridge piers from the effects of anticipated horizontal and vertical movements as the mud layer continued to settle over time.

The Central Section was the first time freeway standard road pavements had been constructed in Western Australia. The finish of concrete bridge structures and retaining walls set new standards

3.

of excellence in public works construction in Western Australia. Among the buildings to be demolished in 1965 to make way for the freeway was the Barracks, a Perth landmark and link with Western Australia's convict beginnings. There was a vehement public outcry over the demolition of the buildings and as a consequence, part of the building complex, the Barracks Arch, on the edge of the freeway cutting, was retained. The Arch stands as a symbol of the beginning of an increased awareness of preserving the built heritage in Western Australia.

#### **Assessed Significance**

The Mitchell Freeway Stage 1 is considered to be of State and National significance.

## **APPENDIX D**

### **Biographies of Key Individuals**

**Sir David Brand, Mr D H Aitken, Mr W H Clough and Mr J G Marsh**



### **Sir David Brand (1912 – 1979)**

David Brand was born in Dongara, Western Australia and educated at Mullewa State School WA.

He joined the AIF in 1939 and was wounded when serving in Greece in 1941. After his discharge from active service in 1942 he served as a sergeant in the Volunteer Defence Corps until the end of the war in 1945.

He joined the Liberal Party in 1944 and won the State seat of Greenough in a 1945 by-election, holding the seat until he retired thirty years later in 1975.

In April 1950 he became Minister for Works, Water Supply and Housing in the McLarty Liberal – Country Party Coalition Government. After the defeat of the coalition in 1953 he became deputy leader of the Opposition and, on McLarty's retirement, Opposition Leader from March 1957. When the Coalition regained power in 1959 he became Premier, Treasurer and Minister for Tourism, positions he held until March 1971. His eleven years, eleven months and one day as Premier exceeded by more than one year Sir John Forrest's record. He was appointed a KCMG in 1969.

David Brand presided over one of the most exciting periods of development in Western Australia's history. His partnership with the then Minister for Industrial Development, Charles Court, proved exceptionally successful. In 1960 the Commonwealth lifted its embargo on the export of iron ore, enabling exploitation of large deposits in the Pilbara.

However in later life he described his work with Sir Russell Dumas to secure the 1952 agreement with Anglo – Iranian Oil Company to establishment the Kwinana refinery as the highlight of his career.

His Government was narrowly defeated at the polls in 1971, Sir David stepped down as Leader of the Opposition in 1972 and he retired from Parliament on 21 August 1975. He died on 15 April 1979.

**EHA ORAL HISTORY NOMINATION**  
**Engineering Heritage Panel WA Division**

Nominee : Donald Hector Aitken

Born : 1925

Address : Ocean Garden Retirement Village, 60 Kalinda Drive, City Beach WA

Career Summary :

Don Aitken graduated with a Bachelor of Engineering Degree with Honours from the University of Western Australia in 1946. He immediately joined the Main Roads Department of WA as an Assistant Engineer.

After early involvement in materials research and metropolitan and south west construction work he spent twelve months in the United Kingdom gaining wider experience.

In 1953 he commenced a demanding period in charge of various Departmental regional operations throughout Western Australia. In the process he gained a thorough knowledge of the State's road needs and the road construction techniques required to suit widely different geographical conditions.

When appointed Chief Engineer in 1964 he had served the Department throughout most regions of the State.

His early achievements with the Main Roads Department included the establishment of the Department's first soils laboratory, installing Perth's first set of traffic lights and developing the use of coastal limestone as a road base material.

On April 29, 1965, at the age of 40 years, Don Aitken was appointed Commissioner of Main Roads for Western Australia – the youngest engineer ever appointed to that position. Upon his retirement as Commissioner of Main Roads on 23 October, 1987, he had held the position for more than 22 years, making him the States's longest serving Commissioner of Main Roads.

Don Aitken had a long and distinguished association with the University of Western Australia. Elected to the Senate in 1967, he was a member of the Engineering Advisory Committee of the Faculty of Engineering from 1968 to 1981, Chairman of the Senate Buildings Committee 1972 – 1978, Pro Chancellor 1975 – 1981, Inaugural Chairman, Engineering Graduates Association of UWA 1978, and its patron since 1981, Chairman of the Senate Investments and Endowments Committee from 1979 and Chancellor of the University from 1981 to 1990. He was the first engineer elected to this high office.



Don Aitken is a Fellow of the Australian Academy of Technological Sciences and Engineering, Fellow of the Chartered Institute of Transport, Fellow of the Australian Institute of Management and is an Honorary Fellow of the Institution of Engineers Australia.

On retirement from the Main Roads Department he accepted an appointment to join the Board of the Western Mining Corporation.

#### Honours and Awards

Companion of the Imperial Service Order 1977, Queen's Silver Jubilee Medal 1977, Australian Road Federation's John Shaw Award for "meritorious contributions to roads" in 1980, elected a Citizen of the Year in Western Australia in 1982 for the category representing the professions and presented with the Institution of Engineers Peter Nicol Russell Memorial Medal in 1982. Don Aitken was appointed an Officer of the Order of Australia in 1988.

#### National Significance

Don Aitken has been a Member and Past Chairman of the National Association of Australian Road Authorities, Director and Past Chairman of the Australian Road Research Board and Member of the Australian Transport Advisory Council Road Group. He was an Honorary Member and former President of the Road Engineering Association of Asia and Australasia.

#### Historical Significance

The Main Roads Department of Western Australia is responsible for the network of major roads and bridges in Australia's largest state. During his long career as an Assistant Engineer, Chief Engineer and Commissioner Don Aitken gave exceptional service to his State during a period of unprecedented expansion of the metropolitan and country road network. Under his leadership the Main Roads spent more than \$2,700 million in maintaining, upgrading and improving Western Australia's public road system, including more than 600 new bridges. This expenditure was vital in facilitating the post war expansion of Western Australia's agricultural and mining industry.

**EHA ORAL HISTORY NOMINATION**  
**Engineering Heritage Panel WA Division**

Nominee : William Harold Clough

Born: 30 September 1926

Address : 23 The Coombe, Mosman Park, WA 6012

**Career Summary**

Harold Clough graduated from the University of Western Australia in 1947 with a first class honours degree of Bachelor of Mechanical Engineering. In 1951 he was awarded a United States Fulbright Scholarship and attended the University of California where he gained a Master of Science degree. For the following two years he remained in the United States with Bechtel Corporation before returning to Western Australia to join his father's building construction firm, J O Clough and Son Pty Ltd, which subsequently became the Clough Engineering Group.

In 1957, under his guidance and vision, his company joined with international engineering firm Christiani and Nielsen A/S of Copenhagen, to successful tender for and construct Perth's landmark Narrows Bridge.

Over the next 45 years he guided Clough during its involvement in numerous major construction projects in Australia and overseas before he stepped down as Chairman of Clough Limited, the holding company, in 2002.

**Honours and Awards**

Harold Clough was awarded the Queen's Silver Jubilee Medal in 1977, Officer of the Order of the British Empire in 1979, Officer of the Order of Australia and an Honorary Degree of Doctor of Engineering, both in 1980. In 1991 he became an Honorary Fellow of the Institution of Engineers Australia. In 1993 he was awarded the James N Kirby Award by the Australasian Board of the Institution of Electrical Engineers and the Peter Nicol Russell Memorial Medal by the Institution of Engineers Australia. In 1994 he was honoured with the inaugural gold medal for his contribution to engineering, industry and commerce by the WA Division of the Australian Institute of Company Directors. In 1997 he was jointly awarded the International Business Corporation Business Award and also the Australian Constructors Association Award for over 50 Years Service to the Australian construction industry. In 2005 he was awarded the Sir Edward "Weary" Dunlop Medal for long term commitment to enhancing the quality of life in the region and improving Australia-Asia relations.



### National Significance

In addition to recognition by his peers, clients and industry associates as listed in the previous section his contribution to the growth of Australia's export trade has resulted in his frequent participation in overseas trade delegations, diplomatic missions and industry conferences. He was a member of the Board of the Australian Government's Australian Indonesia Institute, Austral Asia Centre, the Australia Malaysia Cultural Foundation Inc. and Patron of the Korean Chamber of Commerce in Western Australia. He has previously been Chairman of the Western Australian Trade Advisory Council, a member of the Trade Policy Advisory Council and the White Paper Advisory Panel on Foreign Trade and Policy to the Australian Government.

### Historical Significance

Harold Clough's enterprise in inviting in 1957 the experienced Danish bridge building company Christiani and Nielsen A/S to Western Australia to construct, in joint venture, Perth's Narrows Bridge has significant historical significance. The bridge was the first major civil engineering public works contract awarded in Western Australia. Subsequently Clough, in its own right, constructed the two other major Perth metropolitan area bridges over the Swan [Stirling Bridge, Fremantle] and Canning [Mt Henry Bridge, Mt Pleasant] rivers.

**EHA ORAL HISTORY NOMINATION**  
**Engineering Heritage Panel WA Division**

Nominee : John Gilbert Marsh

Address 4/93 High Street, Fremantle, Western Australia

Born 22 November 1925

**Career Summary**

Graduating from the University of Western Australia in 1946 with a Bachelor of Engineering Gilbert Marsh joined the Main Roads Department WA as an engineer in the Bridges Branch, working under the direction of the Bridge Engineer, E. W. Godfrey. During this period he gained experience in most aspects of bridge investigation and design, and of bridge construction, using both direct labour and contract workforces. His most significant project was the design and construction of two steel and concrete composite bridges over the Swan River at the eastern approaches to Perth, between 1947 and 1952.

He was promoted to Assistant Bridge Engineer in 1954 and appointed Bridge Engineer in 1957. In 1954 government approval was given for the construction of a bridge over the Swan River at a location known as "The Narrows". He was responsible for the design and supervision of the reclamation work for the northern and southern approaches and liaison with the overseas consultants appointed to design the Narrows Bridge.

In 1961 Gilbert Marsh was awarded a Gledden Travelling Fellowship by the University of WA which enabled him to travel to the UK for twelve months, where he worked with consultants and contractors for six months and then undertook studies in soil mechanics at Imperial College, London, under Professor Sir Alec Skempton. His particular interest was in techniques which could be used for the rapid consolidation of the mud under the future Narrows Interchange.

During the 1960's the Main Roads commenced a programme of road construction, including freeways and arterial roads in the Perth Metropolitan area and the construction of a new National Highway across the northwest Pilbara and Kimberley regions. This involved the construction of many bridges and between 1962 and 1985 Marsh created and supervised a large professional organization which undertook the investigation and design of the majority of the bridges built during this period.

Marsh held the position of Bridge Engineer in Main Roads for 28 years, from 1957 up to his retirement in 1985.



## Honours and Awards

In recognition of his involvement with NAASRA [now AUSTROADS] Marsh was awarded in 1992 the John Shaw award for Meritorious Contribution to Roads by the Australian Road Federation.

In 1999 Gilbert Marsh was awarded the Engineers Australia John Connell Gold Medal. This medal is awarded to a structural engineer, widely recognised as holding eminent standing within the profession, who, inter alia, has made a significant contribution, preferably nationally and internationally, to the standing and prestige of the structural engineering profession.

## National Significance

During the period 1957 to 1985 Marsh was an active member of the Bridge Committee of the National Association of Australian State Road authorities [NAASRA]. This committee consisted of the Bridge Engineers from each of the State Road Authorities and was formed with the aim of encouraging and facilitating the adoption of uniform Australian practice in the design, construction and user aspects of bridges. He played a leading role in these activities and also presented over 20 technical papers on bridge and foundation engineering over the course of his career.

From 1980 to 1983 Marsh was the Australian Representative on the Permanent international Association of Road Congresses [PIARC] Technical committee on bridges, culminating in the PIARC XVII World Congress in Sydney in 1983. He was also Chairman of NAASRA [now AUSTROADS] Bridge Design Code Committee from 1980 to 1985 and from 1985 to 1992 was Technical Editor for the 1992 AUSTROADS Bridge Design Code.

## Historical Significance

Among the many innovations of historical significance introduced during Marsh's tenure as MRD WA Bridge Engineer were :-

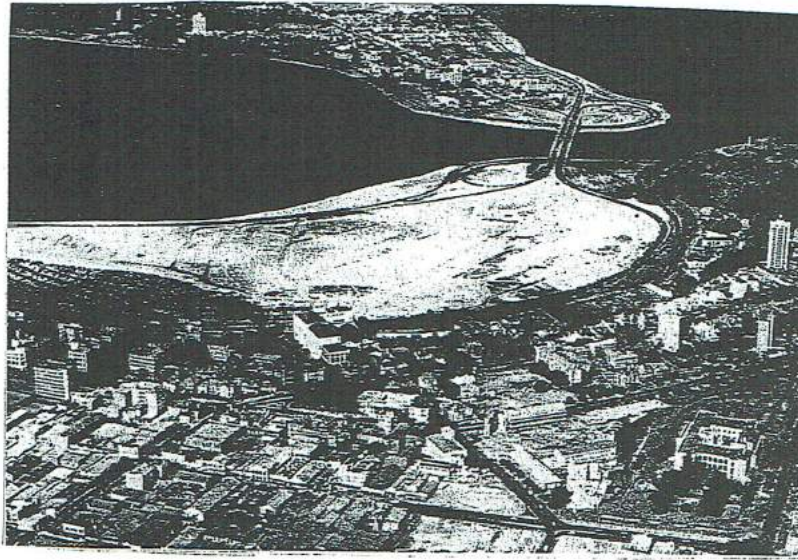
- The adoption of partial prestress in bridges, a footbridge over Canning Highway in Perth was the first partially prestressed bridge designed and built in Australia.
- The introduction of incremental launching technique for concrete bridges, the Mandurah Bridge was the first incremental launched bridge designed in Australia.
- The initial development of "Culway", a "Weigh-in-Motion" system for measuring and continuously recording axle loads of heavy vehicles as they pass over a culvert fitted with strain gauges.

The achievements and experiences of Gilbert Marsh are historically significant because of the senior position he held within the Main Roads Department of WA when a vast and rapid expansion of WA's road network occurred to meet the needs of extensive mineral, agricultural and tourist development, particularly in the north west. During the same period he played a leading role in national organisations during a time of significant change and development in bridge engineering.

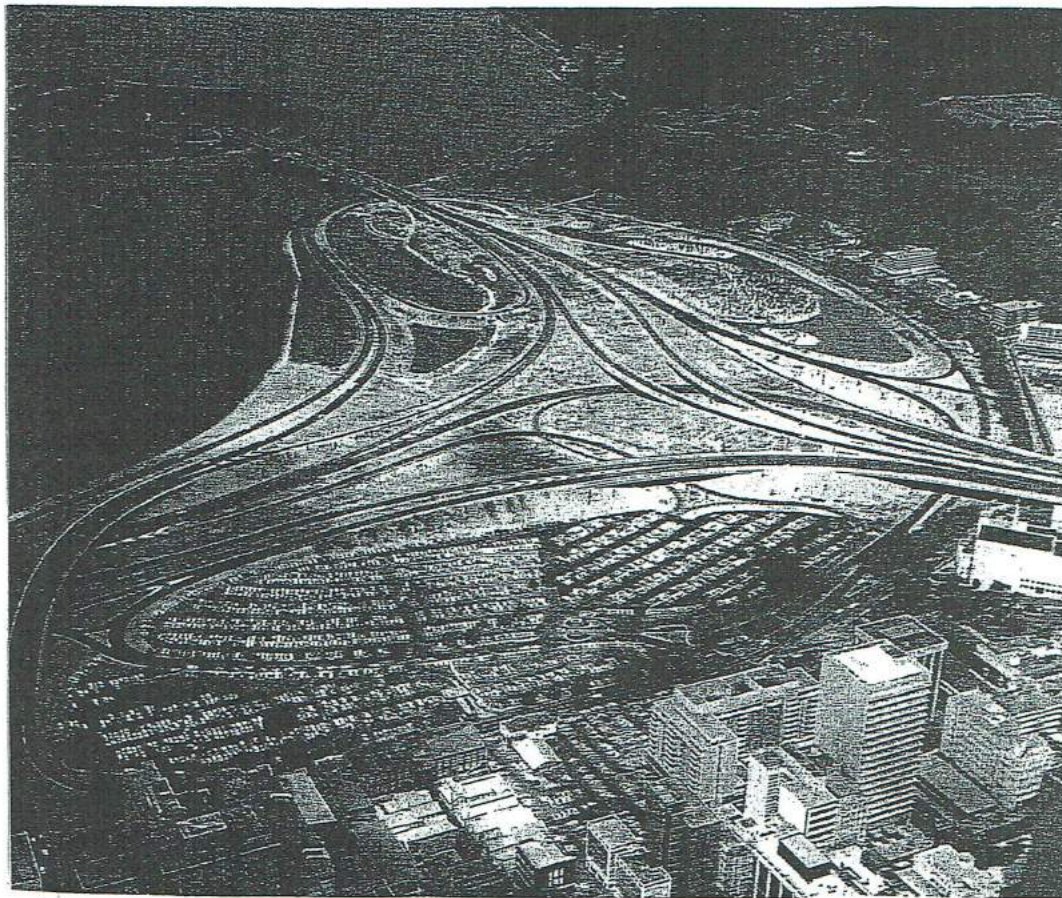






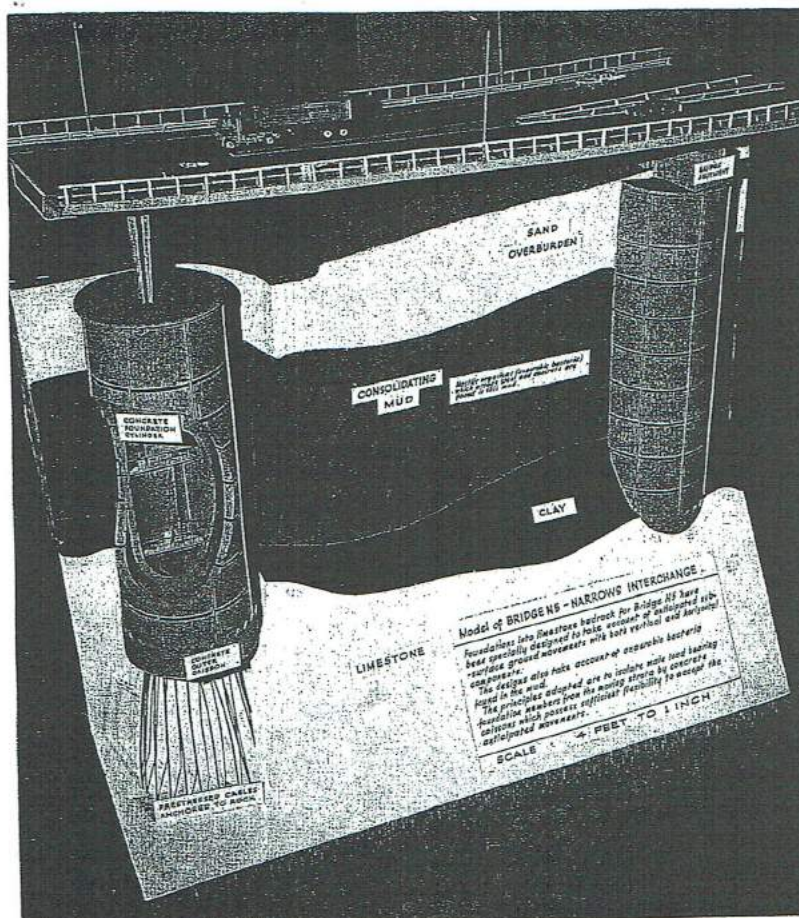


Early stages of work on the Narrows Interchange  
with filling taking place, ca 1965

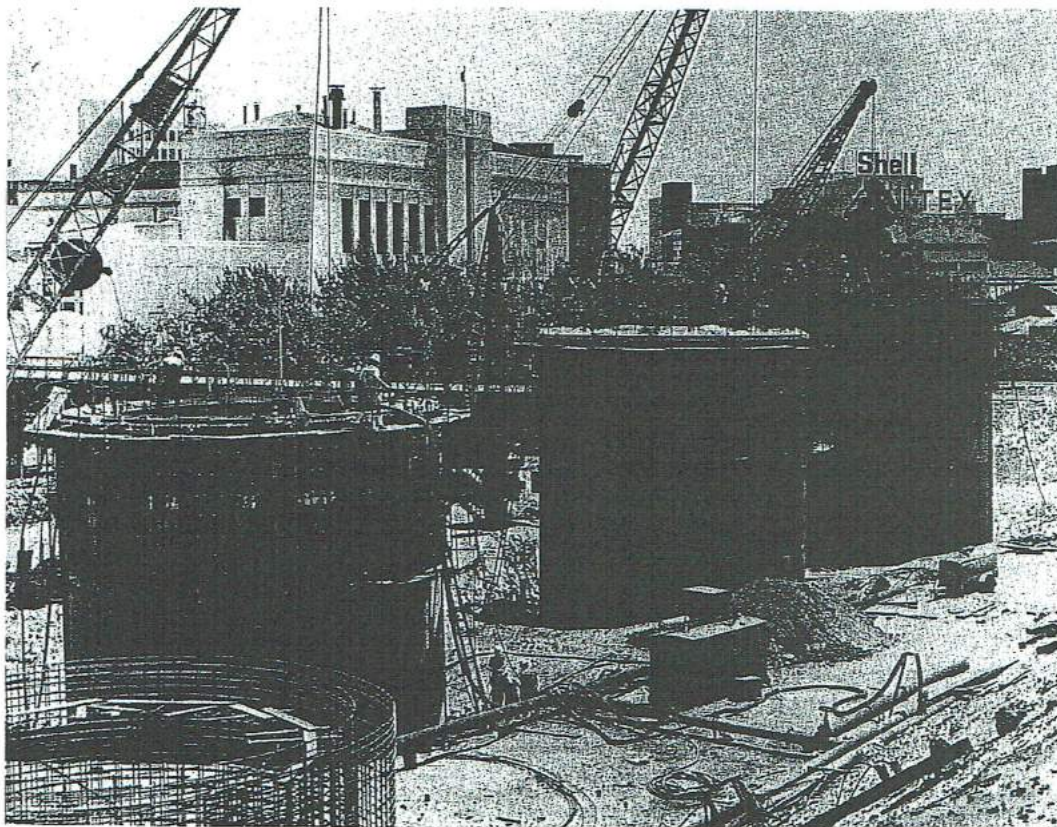


The completed Narrows Interchange



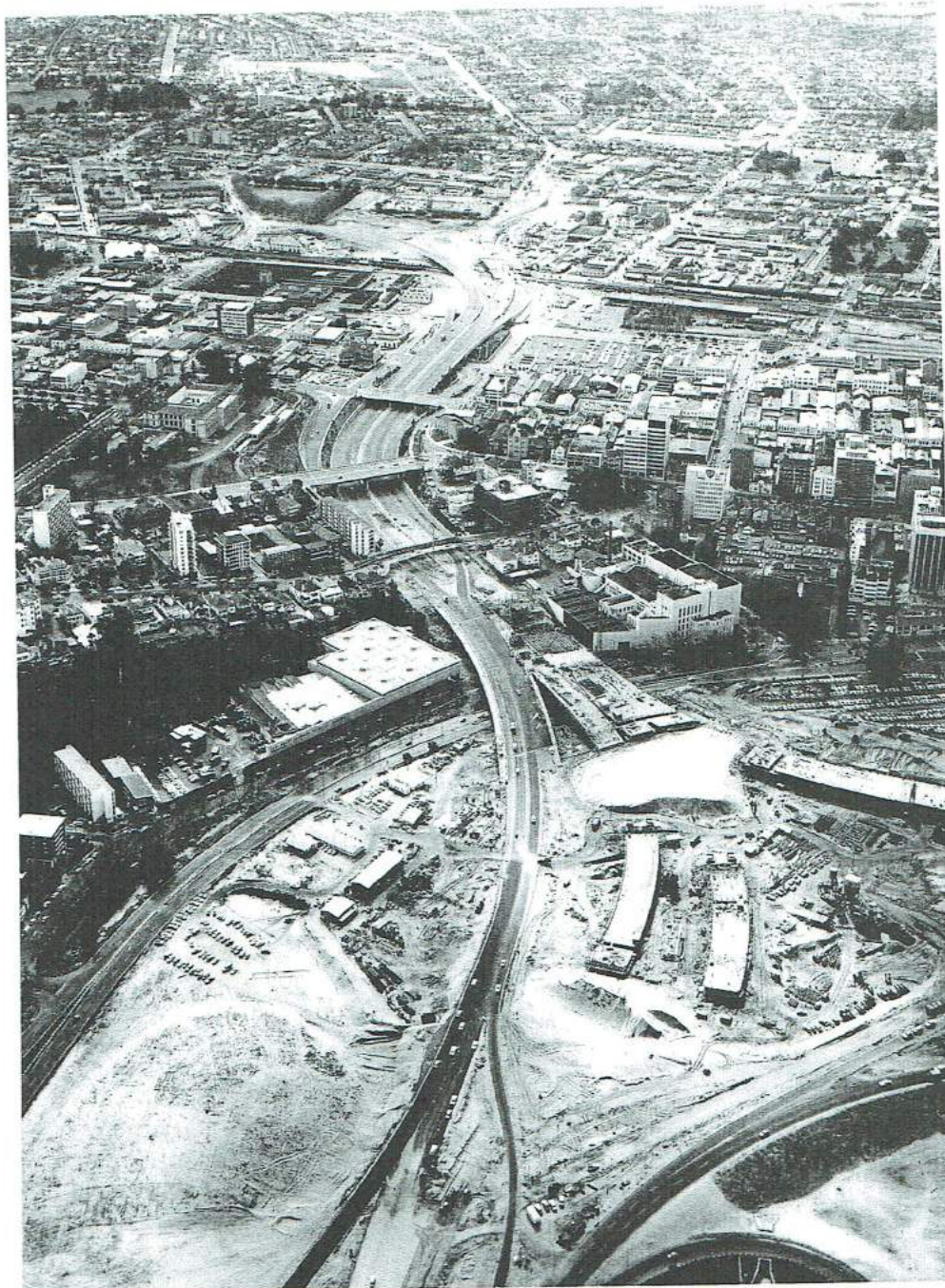


Model showing caissons for Narrows Interchange Bridge N 5



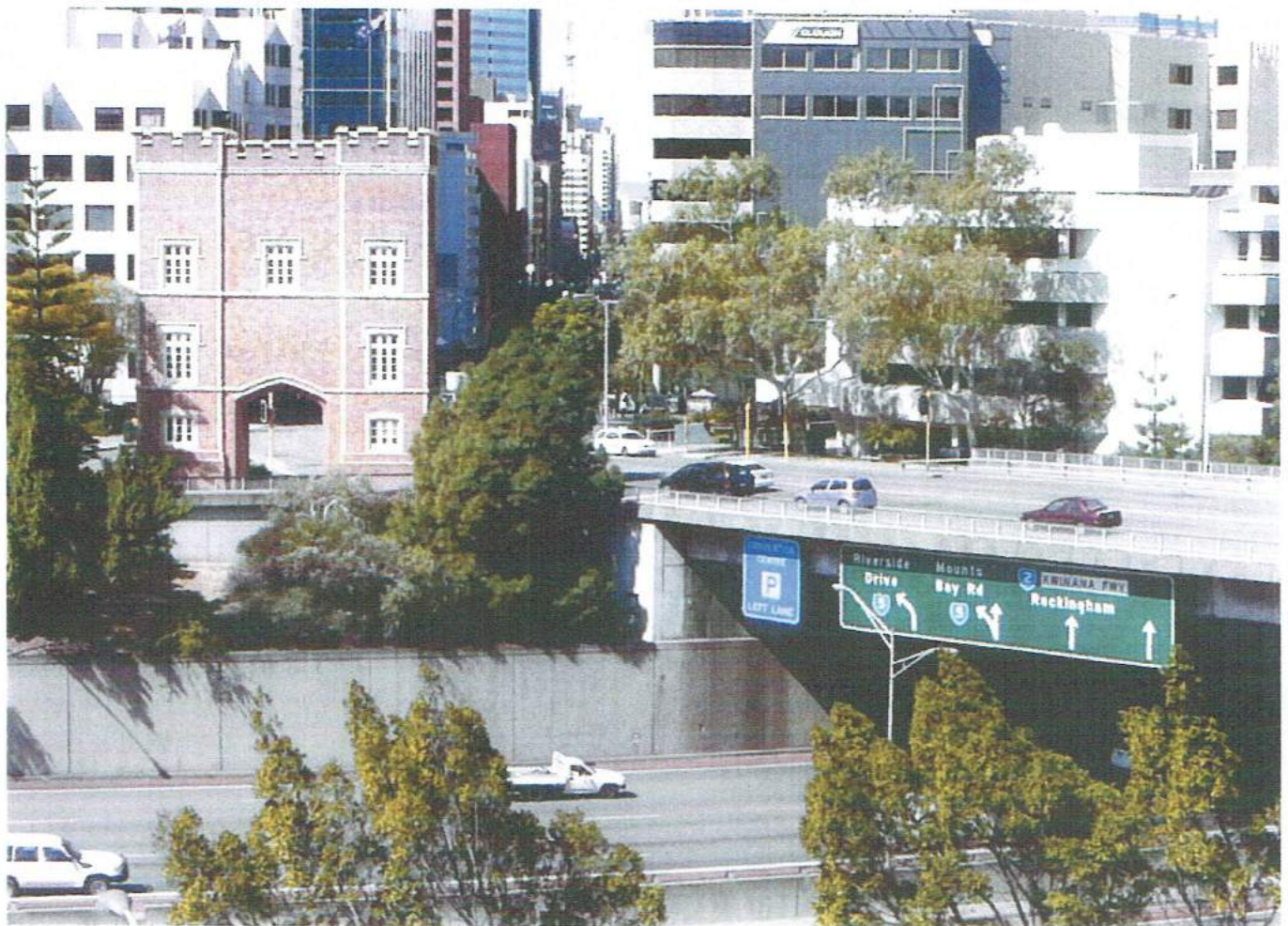
Construction of Narrows Interchange caissons





**The Narrows Interchange under construction, July 1972  
Beyond is the Central Section and the Hamilton Interchange**





Central Section with Malcolm Street Bridge and the Barracks Arch